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AIR SINUS PARASITISM AND PATHOLOGY IN FREE-RANGING COMMON DOLPHINS (Delphinus delphis) IN THE EASTERN TROPICAL PACIFIC

BY

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AIR SINUS PARASITISM AND PATHOLOGY IN FREE-RANGING COMMON DOLPHINS (*Delphinus delphis*) IN THE EASTERN TROPICAL PACIFIC

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INTRODUCTION

The trematode parasite Nasitrema sp. is documented to be a major factor in natural mortality in individual strandings of Delphinus delphis in southern California (Ridgway and Dailey, 1972; Schroeder et al, 1973; Parker et al, 1977; Dailey and Walker, 1978).

Though this parasite normally occurs in the air sinus and inner ear cavities, it has been known to migrate into the brain where it typically causes extensive lesions of both chronic and acute types, indicating that these infections may persist for an extended period of time prior to causing death of the host (illustrated in Dailey and Walker, 1978).

Cowan et al. (Ms.) report on incidence of 98% air-sinus parasitism and associated pathology of the central nervous system in 40 individually stranded D. delphis in southern California. Perrin and Powers (1980) demonstrated that parasitism (by a nematode) plays a significant role in the natural mortality of spotted dolphins, Stenella attenuata, in the eastern tropical Pacific.

From these accounts it is evident that a systematic study of wild free-ranging D. delphis is much needed to assess the incidence and effects of air-sinus parasitism on populations of this species of dolphin in the eastern Pacific.

Recently 104 heads from D. delphis taken in the tuna fishery were systematically examined for parasitism and pathology.

MATERIALS AND METHODS

A sample of 104 intact frozen heads was available for examination. All specimens were obtained through the Southwest Fisheries Center and were taken incidentally in commercial fishing operations. Three specimens were taken in 1978; the rest were collected in 1977 (Table I).

Any discussion on incidence of parasitism should take into account zoogeography and stocks or sub-populations of the host species. This sample was drawn from three sub-populations of eastern tropical Pacific D. delphis: 1) baja neritic (1.9%); 2) northern tropical (15.4%); and 3) central tropical (82.7%). (See Table II.) Since the northern tropical samples were collected at the northern limit of distribution, differentiation between the baja neritic and northern tropical stocks must remain tentative at this time. (See Smith, 1979 for definitions of stocks.) Those appearing in the data as "baja neritic" were positively identified through external morphometric data on adult animals.

Due to the small size of the baja neritic and northern tropical population samples, detailed discussion here on air-sinus parasitism in relation to population structure is confined to the central tropical sample. A sample-size problem also exists for the central-tropical sample in that only one animal under 150 cm total length was available for examination (Figure 1).

Identification of the air-sinus trematode, Nasitrema, to species would be premature at this time and beyond the scope of this report; however,

during the course of the study it was evident that at least two, or possibly three, morphotypes of Nasitrema sp. exist in the sample collected. Research into the potential use of this parasite as a natural biological tag in stock identification is planned for the future.

Complete examination and retrieval of parasites and tissues from the air sinus complex was conducted. Total removal of parasites was accomplished through initial flushing with a moderate stream of water and subsequent incising of surrounding tissue to remove embedded worms. Notes were made indicating presence or absence of pathologic changes in the lining of air sinuses. Subsequent to air sinus examination, the brains were removed intact and placed in 20% formalin for fixation.

Fixed brains were then sent to the University of Texas Medical School, Houston, Texas for pathologic examination after weighing. Brains were serial-sectioned at three-millimeter intervals, some in the coronal, some in the horizontal, and some in the parasagittal plane using a Hobart Model 1612* rotary slicing machine. Each section was inspected for evidence of pathology.

RESULTS

I. Parasitism:

Two genera of parasites were recorded from the air sinus cavities: the trematode, Nasitrema sp., and the sinuous nematode, Crassicauda sp.

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Nasitrema sp. was the most commonly encountered (89% rate of infection). Occurrence of Nasitrema sp. in the three stocks of D. delphis sampled is presented (Table II). A plot of numbers of worms compared to host length and sex for the central tropical sample is presented in Figure 2. Of those infected, 86.3% had fewer than 40 trematodes. In all instances of severe infection (total of 100 or more parasites), all of the hosts were males (6.9% of those infected).

The average number of Nasitrema sp. per animal was higher for the baja neritic and northern tropical stocks (Table II); however, conclusions should be tempered by the small sample size examined (total of 18 animals; 5.8% of the sample).

A nematode, Crassicauda sp., has been documented to be associated with mortality of the spotted dolphin, Stenella attenuata, in the eastern tropical Pacific (Dailey and Perrin, 1973; Perrin and Powers, 1980). Incidence of Crassicauda sp. in the central tropical D. delphis stock was 34.9%. This parasite did not occur in the baja neritic and northern tropical sample examined (Table II). Incidence of infection compared to total length for the central tropical sample is presented (Figure 3) and reveals a pattern similar to that of Dailey and Perrin (1973), in that using length as the index of age, the rate of infection decreases with age (or total length) of the animal. This suggests that Crassicauda sp. infections in the central tropical population may be associated with a moribund condition as has been described for Stenella attenuata (Perrin and Powers, 1980). No association between incidence of infection and sex of host was evident.

II. Pathology

Air Sinuses

Air-sinus tissue pathology related to the presence of Nasitrema sp. was evident in all animals in which a total of 58 or more worms were present (10.9% of those infected). No pathology was observed in infections involving fewer than 40 trematodes (86.3% of those infected). Severe tissue damage was associated with all infections involving a total of 100 or more of these parasites (6.9% of those infected).

Tissue damage ranged from moderate focal sharp-edged ulceration of the epithelium to extensive mucosal ulceration and fibrosis accompanied by mucoid and hemorrhagic exudate in severe cases. The latter is typical of southern-California beach-stranded D. delphis (Cowan et al., Ms.).

In those animals infected by the nematode Crassicauda sp., very little tissue reaction was noted in the mucosal lining. This worm is typically encountered embedded in the bone and coiled beneath the mucosa in the pterygoid and supraorbital areas with the caudal end of the worm dangling free within the air sinus cavity. Detailed examination of bone tissue was not conducted as the crania were destined to be prepared for systematic studies.

It was evident during this study that the presence of Crassicauda sp. was not always associated with the typical cranial bone lesions described for Stenella attenuata (illustrated in Dailey and Perrin, 1973). The disparity between presence of this parasite and absence of bone lesions was particularly evident in adult-sized animals. It is possible that Crassicauda related

bone erosion may be associated with juvenile animals in which the cranial bone development is still incomplete.

Future examination of these prepared specimens is required to assess the pathologic aspects of this parasite.

Brain

One hundred and one brains were serial-sectioned and examined for evidence of pathology. No lesions related to parasitism were encountered. One brain (WOK-138) had a porencephalic cyst, apparently unrelated to parasitism. This round 2.5-cm-diameter lesion extended 10 cm into the left frontal pole. Porencephaly is typically associated with birth related or perinatal injury, with subsequent disturbance of neural development.

SUMMARY

1) Nasitrema sp. occurs in the baja neritic, northern tropical, and central tropical populations of D. delphis in the eastern tropical Pacific. Analysis of occurrence of this parasite with total length of hosts indicates severe infection with related air-sinus pathology occurring in 6.9% of those infected. All were males. We do not consider the degree of air-sinus pathology observed to be severe enough to be a direct cause of mortality; however, it could be an associated indication of the general health condition of the host and contribute indirectly through a combination of other disease factors and/or environmental stress to natural mortality in this population.

2) The nematode parasite Crassicauda sp. occurred in 34.9% of the central tropical D. delphis sample. None were encountered in the baja neritic or northern tropical samples. Comparison of occurrence of this parasite with total length of host in the central tropical sample indicates a similar pattern for that reported to be associated with natural mortality of Stenella attenuata in the eastern tropical Pacific.

3) Brain pathology has been documented in individually stranded D. delphis in southern California (northern temperate population). One hundred and one brains from wild caught D. delphis from the eastern tropical Pacific were examined in detail. No parasite-related pathology was encountered; however, due to limitations in size and age structure of the sample, we cannot rule out such an occurrence.

4) Preliminary results of this study indicate further research would be useful to attempt to utilize these parasites as natural biological tags.

5) The sample of D. delphis available for study is too limited to make any definitive statements on the relationship between air sinus parasitism and mortality in eastern tropical Pacific D. delphis, particularly in regards to the incidence of Crassicauda sp. Examination of additional age-stratified samples from the study area would be useful.

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TABLE I

Summary of specimens of eastern tropical Pacific Delphinus delphis

included in air sinus parasite sample

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number Nasitrema sp.	Crassicauda sp.
230	006	TRK-207	06°55'N; 080°40'W	77-04-21	M	191.0	780	139	A*
		TRK-208			F	159.0	535	0	P
		TRK-209			M	190.0	705	27	P
		TRK-210			M	173.0	640	156	A
		TRK-211			F	156.0	620	9	P
		TRK-212			M	191.0	755	225	A
		TRK-213			M	196.0	540	405	A
		TRK-214			F	192.0	740	2	A
		TRK-215			M	206.0	725	17	A
		TRK-216			F	168.0	530	59	P
		TRK-217			M	200.0	640	149	A
		TRK-218			M	167.0	540	33	P

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number *Nasitrema* sp.	*Crassicauda* sp.
230	010	TEB-009	08°19'N; 086°48'W	77-07-22	F	198.0	830	11	A
	079	TEB-008	09°55'N; 095°07'W	77-06-21	M	180.5	730	0	A
	106	TEB-010	08°19'N; 92°36'W	77-07-22	M	209.0	690	25	A
		TEB-011			F	185.0	800	0	P
		TEB-012			F	95.0	U.D.	0	A
		TEB-013			F	194.0	595	1	A
		TEB-014			F	191.0	690	8	A
	124	TEB-025	09°10'N; 086°48'W	77-08-09	F	188.0	840	18	A
		TEB-026			M	179.5	640	0	A
	125	TEB-028	08°55'N; 086°37'W	77-08-09	F	170.0	700	11	A
		TEB-029			F	168.0	580	0	P
		TEB-030			M	183.0	655	0	P
		TEB-031			M	194.0	610	0	A
		TEB-032			M	185.0	920	4	A
		TEB-033			M	152.0	590	0	P

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number *Nasitrema* sp.	*Crassicauda* sp.
230	125	TEB-034	08°55'N; 086°37'W	77-08-09	F	170.0	620	2	A
		TEB-035			M	159.0	640	1	P
		TEB-036			F	160.0	615	1	P
	132	TEB-037	08°16'N; 086°32'W	77-08-14	F	191.0	640	55	A
	133	TEB-040	08°56'N; 086°19'W	77-08-15	F	190.0	890	17	A
		TEB-041			F	181.0	635	3	P
		TEB-042			F	172.0	710	2	P
		TEB-043			F	155.0	515	2	A
	134	TEB-044	09°33'N; 086°19'W	77-08-16	F	192.0	720	8	A
		TEB-045			M	191.0	730	1	A
		TEB-046			F	170.0	760	3	P
		TEB-047			F	190.0	850	10	A
		TEB-048			M	187.0	770	2	A
	135	TEB-049	09°16'N; 086°27'W	77-08-16	F	195.0	700	17	P
	136	TEB-050	08°25'N; 086°16'W	77-08-17	F	204.0	635	7	A
		TEB-051			F	198.0	685	1	P

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number *Nasitrema* sp.	*Crassicauda* sp.
230	136	TEB-052	08°25'N; 086°16'W	77-08-17	M	170.0	655	4	P
		TEB-053			F	178.0	635	5	A
238	012	RLW-001	07°48'N; 084°58'W	77-05-18	M	190.5	630	2	A
		RLW-002			M	182.0	615	11	P
		RLW-003			F	168.2	545	2	P
	043	RLW-044	08°22'N; 086°27'W	77-06-25	F	193.0	620	7	A
		RLW-045			M	181.0	540	4	P
		RLW-046			M	185.0	630	6	A
257	048	WOK-030	08°53'N; 086°27'W	77-07-20	M	174.0	685	1	P
		WOK-031			F	200.0	575	4	A
	050	WOK-032	08°11'N; 092°47'W	77-07-22	M	221.0	700	35	A
	051	WOK-034	07°55'N; 092°33'W	77-07-23	M	203.0	700	10	A
		WOK-035			M	197.0	655	7	A
		WOK-036			M	219.0	680	13	P
		WOK-037			M	202.0	650	3	A
		WOK-038			F	192.0	610	47	A

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number *Nasitrema* sp.	*Crassicauda* sp.
259	048	TRK-307	08°45'N; 092°20'W	77-07-20	M	194.0	745	7	P
		TRK-308			F	197.0	635	29	A
	049	TRK-309	08°22'N; 092°50'W	77-07-21	M	159.0	670	0	P
269	009	PRT-001	08°50'N; 087°45'W	77-07-24	M	197.5	740	1	A
		PRT-002			F	191.0	645	21	A
	020	PRT-005	09°15'N; 087°25'W	77-08-06	F	167.0	560	0	A
		PRT-006			F	167.0	655	10	P
271	003	JCB-002	22°48'N; 110°52'W	77-07-10	F	167.0	605	203	A
		JCB-003			F	174.0	745	42	A
		JCB-004			M	156.0	650	164	A
		JCB-005			M	167.5	740	112	A
		JCB-006			F	137.2	550	0	A
273	005	JPP-002	22°09'N; 111°52'W	77-07-18	M	181.0	655	175	A
		JPP-003			F	114.2	415	0	A
	013	JPP-004	25°38'N; 112°35'W	77-07-25	M	228.0	890	211	A
		JPP-005			M	182.0	695	49	A

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number Nasitrema sp.	Crassicauda sp.
273	021	JPP-006	22°50'N; 111°20'W	77-08-14	M	177.3	695	108	A
	022	JPP-007	23°15'N; 111°10'W	77-08-14	F	182.5	595	5	A
		JPP-008			F	187.2	740	156	A
		JPP-009			F	unk.-mature	540	205	A
		JPP-010			M	186.0	740	9	A
	025	JPP-011	23°10'N; 111°25'W	77-08-19	M	187.3	700	71	A
282	041	KLW-036	07°38'N; 088°33'W	77-09-11	F	192.0	595	17	A
		KLW-037			M	167.5	540	9	P
290	003	DAV-051	08°10'N; 089°20'W	77-08-01	M	166.0	575	0	P
		DAV-052			F	195.0	680	10	A
		DAV-053			M	192.0	730	6	A
		DAV-054			F	177.0	730	6	P
		DAV-055			F	188.0	705	2	A
		DAV-058			F	183.0	595	1	A
	013	DAV-129	08°25'N; 087°25'W	77-08-09	F	173.0	585	5	A
		DAV-130			F	183.0	575	2	P

TABLE I (cont'd)

Cruise Number	Set Number	Field Number	Position	Date of Collection	Sex	Length (cm)	Brain wt (gm)	Number *Nasitrema* sp.	*Crassicauda* sp.*
290	014	DAV-131	08°50'N; 087°04'W	77-08-09	M	184.0	640	3	A
		DAV-132			M	212.0	685	28	A
		DAV-133			F	181.0	740	3	A
	019	DAV-141	08°14'N; 086°30'W	77-08-13	F	193.0	660	78	A
	028	DAV-160	07°50'N; 087°45'W	77-08-21	M	215.0	730	3	A
		DAV-161			F	168.0	605	2	P
		DAV-162			F	192.0	740	28	A
		DAV-163			M	163.0	780	0	P
	029	DAV-165	07°58'N; 087°35'W	77-08-21	F	193.0	690	65	A
		DAV-166			M	203.0	805	16	A
434	017	WAW-589	22°16'N; 107°52'W	78-10-26	M	236.0	U.D.	50	A
		WAW-590			M	208.0	U.D.	92	A
		WAW-591			F	196.0	U.D.	75	A

* A = Absence of *Crassicauda* sp.; P = Presence of *Crassicauda* sp.

TABLE II

Summary of Crassicauda sp. and Nasitrema sp. infections

in Delphinus delphis from the eastern tropical Pacific

Stock	Number Examined	Occurrence of Nasitrema sp.				Occurrence of Crassicauda sp.	
		Number Infected	Per Cent	Mean Number of Worms	Range	Number Infected	Per Cent
Baja Neritic	2	2	100	130	49 - 211	0	0
Northern Tropical	16	14	87.5	92	5 - 205	0	0
Central Tropical	86	73	85.1	23	1 - 405	30	34.9
Total	104	89	85.6	--	--	30	28.8

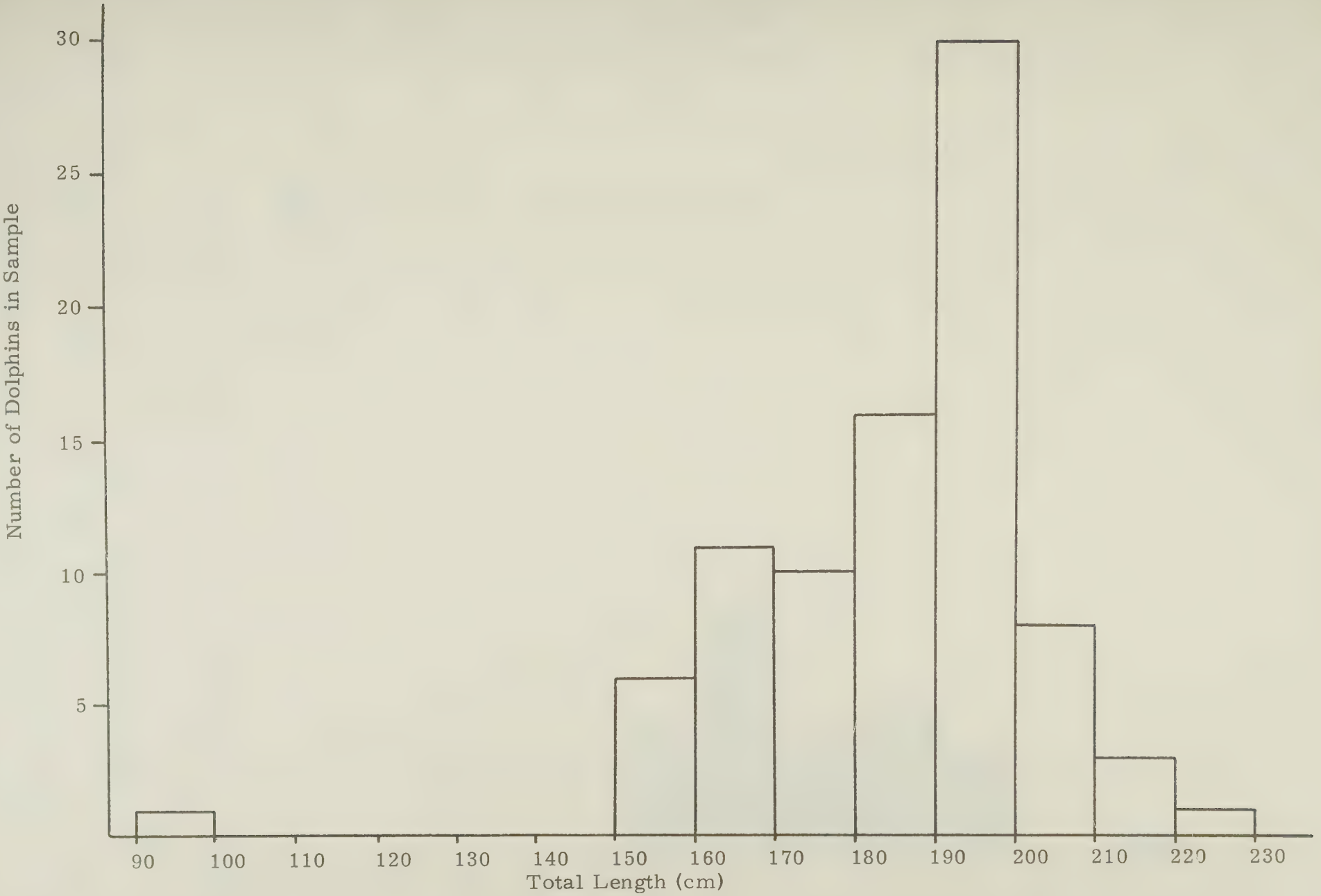

Figure 1. Frequency distribution of lengths of central-tropical specimens of D. delphis

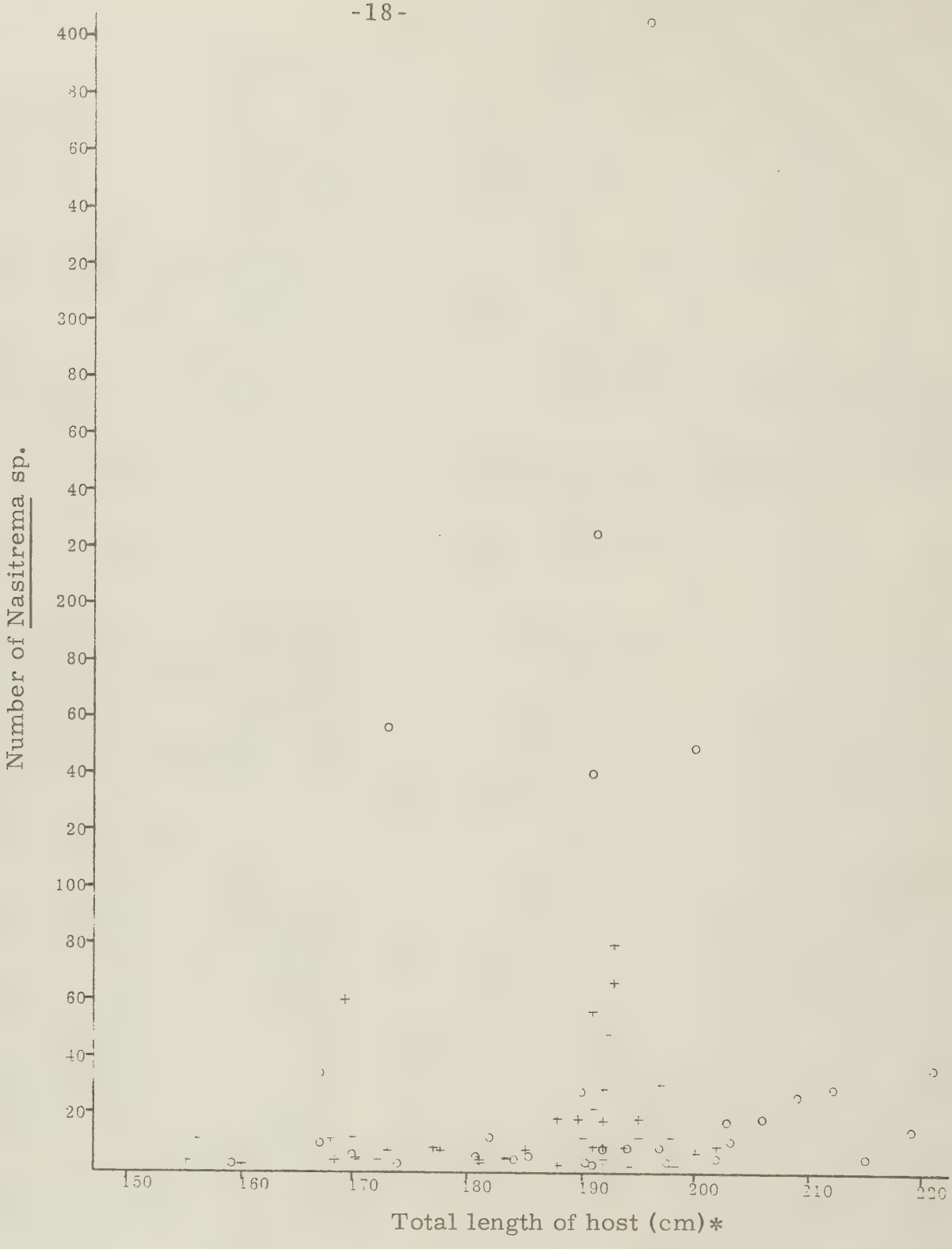

Figure 2. Scatter plot of number of individuals of Nasitrema sp. on length of host in central-tropical population of Delphinus delphis.

* + = female o = male

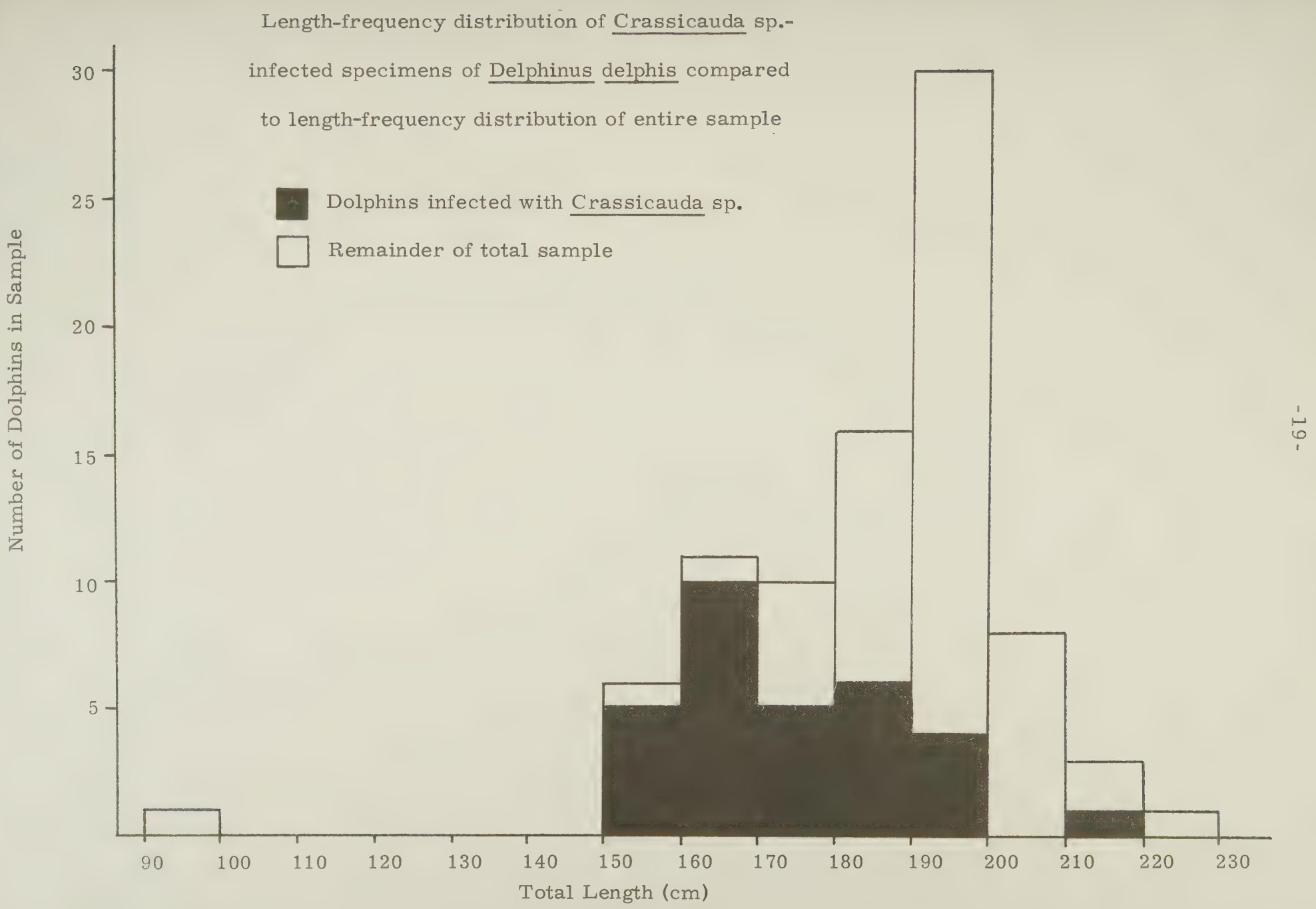
Length-frequency distribution of Crassicauda sp.-infected specimens of Delphinus delphis compared to length-frequency distribution of entire sample
Dolphins infected with Crassicauda sp.
Remainder of total sample
Number of Dolphins in Sample
30
25
20
15
10
5
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
Total Length (cm)

Figure 3